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PHYSICS AND MATHEMATICS

No. 62

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2 April 1980

USSR REPORT

PHYSICS AND MATHEMATICS

No. 62

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USSR

UDC 534.231:535.211

ACOUSTIC PERTURBATIONS IN A MEDIUM DUE TO LIMITED MOTION OF A HEAT SOURCE AT THE SPEED OF SOUND

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 26 No 1, Jan/Feb 80 pp 35-40
manuscript received 22 Jun 79

BOZHKOVA, A. I., BUNKIN, F. V. and KOLOMENSKIY, AL. A., Institute of Physics
imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] Motion of three-dimensional heat sources at a velocity approaching that of sound is considered and the resulting acoustic perturbations in the medium are analyzed, this motion being limited by finiteness of the source action. With a sufficiently low source power and a sufficiently short trajectory, the problem can be treated as a transient one without dissipation and nonlinear effects taken into account. Assuming the heat source to be turning on and off instantaneously, and the wave front to be plane, the second-order differential equation for the pressure as a function of the thermal power density is here solved with the aid of a Green's space-time function for zero initial values. The solution reveals that the pressure along the trajectory rises linearly when the path is short within the range where the effect of diffractive divergence remains weak and rises logarithmically when the path is longer with the effect of diffractive divergence becoming strong. The results of this analysis are applicable to a heat source produced by a scanning laser beam in an absorbing fluid. Typical calculations are shown for a Gaussian laser beam scanning a water surface. References 10: 9 Russian, 1 Western.
[106-2415]

USSR

UDC 534.26

PROPAGATION OF ACOUSTIC WAVES THROUGH A PLANE WAVEGUIDE WITH THIN ELASTIC WALLS IN A FLUID MEDIUM

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 26 No 1, Jan/Feb 80 pp 112-121
manuscript received 13 Jun 78; after revision 6 Jul 79

LEVITSKIY, L. A.

[Abstract] The author considers a waveguide formed by two parallel thin elastic plates in an ideal compressible fluid and propagation through it of acoustic waves excited by a harmonic point source inside. The sound pressure is calculated from the Helmholtz equation and the principle of limiting absorption. The equation of dynamics for a plate in a fluid is solved with the continuity of vertical displacements at the plate-fluid interfaces as

the boundary condition. The energy which a surface wave in such a system transmits along a plate, on the inside and on the outside of the waveguide is also calculated. The method of steepest descents is used for the far-field zone. In the case of semitransparent plates some energy is always lost to radiation. Nevertheless every normal mode is found to become strongly underdamped at a certain critical frequency. There is also energy dissipated by the fluid. The ratio of energy transmitted by a wave to energy transmitted along the waveguide increases with a larger wave number, and faster so as the distance between the plates increases. The author thanks D. P. KOUZOV for formulating the problem and for the helpful discussion. Figures 6; references 5 Russian. [106-2415]

USSR

UDC 533.6.011.72+534.2:532

SPECTRUM OF AN INTENSIVE HYDROACOUSTIC PULSE REFLECTED FROM A WATER SURFACE

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 26 No 1, Jan/Feb 80 pp 137-139
manuscript received 11 Mar 79

CORSKIY, S. M., PETUKHOV, YU. V. and FRIDMAN, V. YE., Scientific Research Institute of Radiophysics, Gor'kiy

[Abstract] Reflection at the free water-air boundary of a pressure pulse coming from an acoustic point source at some depth below the ocean surface is considered, cavitation being negligible here as long as the pulse has a not very large amplitude. The spectrum of the reflected pulse reveals a redistribution of energy at the surface, low-frequency components becoming more intensive and high-frequency components becoming less intensive after reflection. Calculations are made for the two extreme cases of detonation occurring near the surface or very deep below it. In the first case one can disregard nonlinear distortion of the incident shock wave and assume that the reflected wave has an exponential profile. In the second case one can assume that the incident shock wave is triangular at the surface and the reflected wave has a profile $p = -(t/x)$ ($0 \leq t \leq x$), $p = (t-1)/(1-x)$ ($x \leq t \leq 1$) when $0 \leq x \leq 1$ and $p = -(t/x)$ ($0 \leq t \leq \sqrt{x}$) when $x \geq 1$. Here x denotes the depth coordinate referred to a characteristic radius and t denotes time referred to a characteristic period. Figures 1; references 4: 3 Russian, 1 Western. [106-2415]

A STUDY OF HYPERSOUND GENERATION BY A COHERENT FOCUSED LIGHT PULSE

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 31 No 2, Aug 79 pp 250-256 manuscript received 19 Mar 79

LITVINENKO, G. I., LOKHOV, YU. N. and FIVEYSKIY, YU. D.

[Abstract] Hypersound generation in the case of Mandelshtam-Brillouin stimulated scattering in a solid optically transparent dielectric by a focused laser pulse is theoretically analyzed for the case of large Stokes component gains. The dielectric is assumed to be isotropic and homogeneous, and lattice inclusions and defects are absent in the focal volume. The focal distance is assumed to be sufficiently small to avoid self-focusing of the laser radiation. The temperature of the focal volume of the dielectric is assumed constant during the scattering process and nonlinear pressure effects are neglected. The limits to the latter assumption are indicated. Since the greatest pumpback of the laser energy to the Stokes components occurs for the case of scattering at an angle of 180° to the direction of laser radiation propagation, this is the case studied here. The three-dimensional problem is solved in a parabolic approximation of the slowly changing amplitudes of the electromagnetic field and hypersound pressure. Expressions are derived for the scattering threshold and they are analyzed as a function of the focal distance of the focusing lens. It is shown that the hypersound generation dynamics account for the experimentally observed widening and shift of the frequency of the Stokes component. A sample calculation for the case of fused quartz and a ruby laser where the focal distance is 6 cm, the pulse width is $2 \cdot 10^{-8}$ and the temperature 300 K, shows that the radiation power density at the focus must be much less than 10^{12} watts/cm². The range of applicability of the expressions derived in the laser field approximation is determined by the hypersound pressure at which the nonlinear pressure processes can be disregarded. References 16: 9 Russian, 7 Western.
[186-8225]

USSR

THE PHASON IN THE SUBMILLIMETER SPECTRUM OF CsCuCl_3 SINGLE CRYSTALS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 31 No 2, Jan 80 pp 107-110 manuscript received 23 Nov 79

VOLKOV, A. A., KOZLOV, G. V., LEBEDEV, S. P., PETTSEL'T, YA. and BRZHEZINA, Z., Physics Institute imeni P. N. Lebedev of the USSR Academy of Sciences

[Abstract] The dielectric spectra of CsCuCl_3 crystals in the submillimeter band were investigated to find excitations of the crystal lattice related to phase transitions leading to a helicoid modulated structure in the low-temperature phase. The CsCuCl_3 crystals were grown from an aqueous solution of cesium and copper chloride in the molecular ratio of 1:2 by temperature reduction in the range of 313-308 K and at pH of 3.5. The observed low-frequency mode is directly related to phase fluctuations of a helicoid modulated structure. Phase transition in CsCuCl_3 crystals is the first recorded case of nonferroelectric phase transition in nonpolar point groups in which one of the soft mode components becomes active in the infrared spectrum. Figures 3; references 9: 3 Russian, 6 Western.

USSR

RESONANCE EXCITATION OF Nd^{3+} IN A SINGLE CRYSTAL OF A Gd_2S_3 SEMICONDUCTOR

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 31 No 2, Jan 80 pp 114-117 manuscript received 24 Nov 79

GLUSHKOV, M. V., MAMEDOV, A. A., PROKHOROV, A. M., PUKHLIY, ZH. A. and SHCHERBAKOV, I. A., Physics Institute imeni P. N. Lebedev of the USSR Academy of Sciences

[Abstract] The absorption spectra of Gd_2S_3 semiconductor and the emission spectra of a Nd^{3+} ion were investigated by the resonance laser excitation method at different temperatures. The neodymium concentration in the Gd_2S_3 comprised 1 percent by weight. Effective impact collision of impure centers by carriers in the electric field is possible in semiconductors of type $\text{A}_2^{\text{III}}\text{B}_3^{\text{VI}}$ activated by trivalent ions of rare earth elements and these materials can be used as the active medium of a new type of laser. Figures 3; references 6: 5 Russian, 1 Western.

USSR

HEAT-CAPACITY ANOMALIES IN GAMMA-IRRADIATED CRYSTALS OF TRIGLYCIN SULFATE

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 31 No 3, 5 Feb 80 pp 184-187 manuscript received 27 Dec 79

STRUKOV, V. A., SIGOV, A. S., FEDORIKHIN, V. A. and TARASKIN, S. A., Moscow
State University imeni M. V. Lomonosov

[Abstract] The evolution of heat-capacity anomalies in crystals of triglycine sulfate under the influence of small gamma radiation doses is studied for the first time. Comparison of the data produced with a phenomenological theory considering the influence of noninteracting defects on the nature of anomalies in the region of phase transitions is used to estimate the concentration of defects arising in a crystal upon irradiation. Results are presented from studies of the heat capacity of a crystal of TGS grown at a temperature higher than the second order phase transition temperature T_c as a function of gamma radiation dose. The temperature dependence of heat capacity is graphed for several radiation doses. Figures 2; references 3 Russian.

[99-6508]

USSR

UDC 534.2:532

PARAMETERS OF A DETONATION WAVE REFLECTED FROM A WATER SURFACE

Moscow AКУСТИЧЕСКИЙ ЖУРНАЛ in Russian Vol 26 No 1, Jan/Feb 80 pp 150-151
manuscript received 11 Mar 79

PETUKHOV, YU. V. and FRIDMAN, V. YE., Scientific Research Institute of
Radiophysics, Gor'kiy

[Abstract] A wave is generated by detonation of a charge deep under the water surface and then reflected at the surface. The parameters of the reflected wave are calculated here and compared with the corresponding parameters of the wave arriving directly from the source. The profile of the original wave remains exponential near the source, within a characteristic radius, and becomes triangular beyond that radius. When detonation occurs deep below the surface, therefore, then the reflected wave will have a Riemann profile. A directly arriving signal and a reflected signal will be of equal durations at some depths and of equal amplitudes at other depths. In addition to the locus of equal-duration depths and the locus of equal-amplitude depths, there is a third locus of points at which discontinuity in the profile of the reflected wave occurs. Figures 1; references 3 Russian.

[106-2415]

USSR

UDC 532.517

STABILITY OF A BOUNDARY LAYER ABOVE THE SURFACE OF A WAVE TRAVELING THROUGH A PLATE

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСКОY FIZIKI in Russian No 5, Sep/Oct 79 pp 49-52 manuscript received 17 Oct 78

AYZIN, L. B. and VOLODIN, A. G., Novosibirsk

[Abstract] The stability of the boundary layer of an incompressible fluid above a rigid plate surface with a wave traveling parallel to the stream is analyzed, this problem being treated as a two-dimensional one in the linear approximation. The potential in the inviscid region and the flow function for the laminar region are referred to a system of coordinates traveling with the wave. Assuming a Blasius velocity profile and using the Orr-Sommerfeld operator, the solution to the linearized equation for the perturbation flow function is sought in the form of a power series with respect to

the wave amplitude. Numerical integration of this Sommerfeld-Orr equation for a flow with the Reynolds number ranging from 520 to 3500 yields, with appropriate corrections, the limit of neutral stability for a Tolmin-Schlichting wave as a function of the Reynolds number and of the phase velocity. The results indicate that waviness of the surface distorts the steady-state velocity profile within a narrow range, contributing to stability below and causing instability above. The authors thank S. A. GAPONOV for pointing out the analogy between these results and those based on a nonlinear theory. Figures 2; references 6: 5 Russian, 1 Western. [105-2415]

USSR

UDC 533.6.011.55

SUPERSONIC NONEQUILIBRIUM FLOW ALONG THE LATERAL SURFACE OF BLUNT BODIES

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian No 5, Sep/Oct 79 pp 68-72 manuscript received 24 Jul 78

LABNOVA, L. A., POLYANSKIY, A. F. and SKURIN, L. I., Leningrad

[Abstract] A laminar stream of air not at chemical equilibrium along the lateral surface of a blunt cone moving at supersonic velocity is analyzed, assuming the presence of an external electric field and an electric current due to ionization within the flow region but disregarding any effects of radiation. The boundary conditions are given in terms of a zero normal velocity component, a constant temperature and an equilibrium concentration of all gases (O_2 , N_2 , O , N , NO , NO^+ , e) at the body surface. Only mass interdiffusion is assumed to occur, with constant values of the Schmidt number, within the boundary layer. Examined are the normal profiles of temperature and electron concentration, also the dependence of the total hydrodynamic drag coefficient and of the Stanton number on the flight altitude and on the cone geometry, i.e., bluntness radius and divergence angle. Experimental data are shown pertaining to a cone flying at a velocity of 7.4 km/s and compared with those for a cone without blunting of the vertex. Blunting to a radius of 1 cm, with a divergence angle of $9-10^\circ$, is found to raise the ionization level by almost three orders of magnitude but to have little effect on the thermal and the hydrodynamic characteristics. Figures 4; references 15: 6 Russian, 9 Western. [105-2415]

USSR

UDC 532.526+533.6.011.55-3

FLOW WITHIN A SUPERSONIC BOUNDARY LAYER AT BODIES WITH A POWER-LAW PROFILE
AND WITH MASS TRANSFER ACROSS THE SURFACE

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian
No 5, Sep/Oct 79 pp 73-80 manuscript received 25 Oct 78

DUDIN, G. N., Moscow

[Abstract] The author considers supersonic flow around a slender body with a power-law profile in a viscous gas with attendant mass transfer across the surface. Insertion of variables referred to the body surface and letting the Reynolds number become infinite reduces the Navier-Stokes equations to equations of a three-dimensional boundary layer, which written in Dorodnitsyn variables are solved here for boundary conditions corresponding to a wing with a profile $z_e = x^m$ and a boundary layer $\delta_b = x^{1/2} \Delta_b(z/z_e)$ (z_e being the coordinate of the front edge). In the case of forced air injection or suction across the surface, further constraints are imposed and another change of variables is made to bring the problem to a self-adjoint form. Results of calculations are shown which pertain to symmetric flow around a wing, with the viscosity assumed to be linearly dependent on the temperature. The profiles of displacement thickness and thermal flux as well as the profiles of longitudinal and transverse friction stresses are found to change with the rate of injection (positive) or suction (negative). Figures 6; references 7: 5 Russian, 2 Western.
[105-2415]

USSR

UDC 532.529.5

FRICTIONAL STRESS AT A WALL IN AN ASCENDING LIQUID-GAS STREAM

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian
No 5, Sep/Oct 79 pp 80-87 manuscript received 15 May 78

BURDUKOV, A. P., KASHINSKIY, O. N. and ODNORAL, V. P., Novosibirsk

[Abstract] An experimental study was made of frictional stress, at the wall, due to slow ascending flow of a liquid-gas stream through a 6.5 m high vertical pipe with an inside diameter of 86.4 mm. The liquid phase was an aqueous solution of 0.5 N NaOH and 0.01 N $\text{Fe}(\text{CN})_2 + \text{Fe}(\text{CN})_3$, as the gas phase was nitrogen. The mixture was driven through this pipe and another vertical return-flow pipe by a centrifugal pump having a capacity of 50 m³/h at a

pressure head of 6 atm. After each flow cycle the mixture was passed through a separator, from where the nitrogen was exhausted into the atmosphere and the liquid was returned to the pump for further use. Nitrogen was fed into the stream through the lateral surface of a porous pipe and its temperature at the inlet to the main pipe was held at $24 \pm 0.5^\circ\text{C}$. The velocity of the ascending stream was varied from 0.44 to 2.05 m/s and the nitrogen content in the mixture was varied from 0 to 80 vol.%. The frictional stress was measured by the electrochemical method and the gas concentration profiles were measured by the electrical conductivity method, under conditions of bubble flow and shot flow. The gas concentration profiles indicate that the sharp rise of frictional stress during bubble flow with a low gas content is due to sharp peaks of gas concentration near the pipe wall. The velocity of ascending gas bubbles is comparable with the local velocity of the liquid, which distorts the velocity profile and results in a larger velocity gradient at the wall. Figures 6; references 16: 7 Russian, 9 Western. (105-2415)

USSR

UDC 534.833.53

EXPERIMENTAL EVALUATION OF THE RATE OF GROWTH OF MICROBUBBLES IN A TURBULENT STREAM

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСКОY FIZIKI in Russian No 5, Sep/Oct 80 pp 87-91 manuscript received 11 Jul 78

GAVRILENKO, V. G. and MART'YANOV, A. I., Gor'kiy

[Abstract] The authors consider the feasibility of evaluating the rate of growth of free bubbles in a turbulent submerged water jet from measurements of the gas nucleation profile and its evolution along the jet axis. Such an experimental evaluation is based on the equation of continuity with respect to concentration of gaseous nuclei, assuming no instantaneous but only gradual buildup and collapse of bubbles dissolved within the jet region. This equation is solved for the rate of growth when $\frac{d}{dt} \left(\frac{2R}{\rho} \right) \rightarrow 0$ (R denoting the bubble radius and t denoting time). Experiments for such an evaluation were performed in a hydroacoustic tank with bubbles inside a circular tube and within a jet flowing into the tank, the distribution of bubbles within the $(2.25-13) \cdot 10^{-4}$ cm range of radii being measured and the bubble growth rate then being determined as functions of the distance from the nozzle throat. An analysis of experimental data reveals the dynamics of bubble growth in a turbulent stream and indicates that the number of bubbles of any size group is maximum at a distance from the nozzle throat approximately equal

to twice the nominal radius corresponding to this group. The authors thank A. N. BARKHATOV and L. A. OSTROVSKIY for the interest and helpful suggestions. Figures 1; tables 1; references 5 Russian. [105-2415]

USSR

UDC 532.72

CONVECTIVE HEAT AND MASS TRANSFER IN A MOVING REGULAR ARRAY OF DROPS OR BUBBLES WITH HIGH VALUES OF THE PECLET NUMBER

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian No 5, Sep/Oct 79 pp 99-103 manuscript received 14 Aug 78

POLYANIN, A. D. and SERGEYEV, YU. A., Moscow

[Abstract] Convective diffusion is considered in a dense array of precipitating spherical drops or levitating bubbles, all moving at the same velocity in an infinitely large volume of a liquid at rest and forming straight vertical strings separated by a distance of the same order of magnitude as the distance between drops or bubbles in one such string. The boundary layer around each drop or bubble is assumed to be linear. The problem of mass transfer in such an array is solved with the flow function near a surface, according to this model of a Stokes flow, expressed in spherical coordinates. Convective diffusion is here regarded as a quasi-steady process and, on this basis, the equation of steady convective diffusion is solved for drops or bubbles with the Peclet number $N_{pe} \gg 1$, as in an extraction column, and their concentration distribution calculated accordingly. The mean concentration is found to decrease exponentially with time and with distance from the inlet, and to increase exponentially with velocity. This relation, appropriately modified, is useful for calculating the mean concentration of a discrete reactant phase in a continuous dispersing phase at any time at any height in a reactor vessel with a finite volume. Figures 1; references 5: 2 Russian, 3 Western. [105-2415]

LASER-INDUCED CAVITATION IN LIQUID NITROGEN

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСKOY FIZIKI in Russian
No 5, Sep/Oct 79 pp 103-106 manuscript received 10 Oct 78

GOLUBNICHNIY, P. I., DYADUSHKIN, P. I., KALYUZHNYIY, G. S., KORCHIKOV, S. D.
and KUDLENKO, V. G., Voroshilovgrad

[Abstract] An experimental study was made of laser-induced cavitation in a liquid nitrogen. The apparatus consisted of a neodymium laser, a focusing lens and a cryostat made of an optical material containing the liquid nitrogen. The laser pulses were of 10 ns duration with a maximum energy of $3 \cdot 10^{-2}$ J per pulse. Auxiliary equipment included an intensifying helium-neon laser, a photomultiplier and a red filter. The principal cavitation parameter, namely the ratio of maximum to minimum bubble radii, was measured by the shadow method with recording of optical pulse signals. As a result the pressure dependence and the temperature dependence of this ratio were determined as well as the pressure dependence of the period of the first bubble pulsation. The compression ratio was found not to exceed 6, at an excess pressure of 2 atm and a temperature of 65 K. Increasing this ratio requires raising the external pressure and thus lowering the gas content in the nitrogen sample. Figures 5; references 5 Russian.
[105-2415]

USSR

UDC 669.15

AMORPHIZATION OF METALLIC ALLOYS UNDER LASER ACTION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 249 No 5, 1979 pp 1118-1120
manuscript received 27 Jun 79

KYASHKIN, V. M., ZHDANOV, G. S. and MIRKIN, L. I., Moscow State University
imeni M. V. Lomonosov

[Abstract] The authors investigate the action of laser radiation on equi-atomic powder mixtures in the binary systems Cu-Zr and Ni-Nb on massive copper and nickel backings. The powder layers were 0.3 mm thick on backings 6 mm thick. A glass plate was used to press the powder against the backing. Laser emission was produced by a neodymium glass laser in the millisecond pulse mode. Analysis of the resultant alloy structures shows that amorphization occurs in a narrow range of exposure conditions: deviation from the optimum pulse energy by 10-15% produces purely crystal phases. In fact, it was discovered that no completely amorphous alloy could be produced, which may be attributed to nonuniformity of cooling conditions, incomplete mixing of the powders, and the considerable thickness of the alloy layer. Another factor could be vaporization of the components leading to a change in concentration. Figure 1; references 9: 5 Russian, 4 Western.
[86-6610]

USSR

STIMULATED MANDEL'SHTAM-BRILLOUIN SCATTERING IN AN EXTERNAL TRANSVERSE CAVITY

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 31 No 2, Jan 80 pp 103-106 manuscript received 22 Nov 79

ZASKAL'KO, O. P., SERDYUCHENKO, YU. N., STARUNOV, V. S. and FABELINSKIY, I. L., Physics Institute imeni P. N. Lebedev of the USSR Academy of Sciences

[Abstract] The results of experimental investigation of the spectral and time characteristics of stimulated Mandel'shtam-Brillouin scattering in an external transverse cavity, which is a laser that emits picosecond light pulses, are reported. The time and spectral characteristics of stimulated Mandel'shtam-Brillouin scattering did not vary with variation of distance between cavity mirrors from 6 to 9.5 cm, indicating self-locking of the stimulated Mandel'shtam-Brillouin scattering components. Locking of the

cavity modes was found experimentally in the case of stimulated light scattering of the limb of the Rayleigh line and during stimulated Mandel'shtam-Brillouin scattering in long waveguides, and mode locking in both cases occurred within the amplification band of each of the types of light scattering. The experiments indicate that there is a mechanism which creates a hypersonic wave common to all stimulated Mandel'shtam-Brillouin scattering components. Figures 2; references 6: 5 Russian, 1 Western.

USSR

SYNCHRONIZATION OF THE STIMULATED MANDEL'SHTAM-BRILLOUIN SCATTERING COMPONENTS IN A LASER CAVITY

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 31 No 2, Jan 80 pp 136-138 manuscript received 18 Dec 79

VOROB'YEV, N. S., SHIPILOV, K. F. and SHMAONOV, T. A., Physics Institute imeni P. N. Lebedev of the USSR Academy of Sciences

[Abstract] The effect of synchronization of stimulated Mandel'shtam-Brillouin scattering components was investigated as the basis for a new method of short laser pulse generation. The time parameters of the output pulse were measured by means of a coaxial photocell electrooptical chamber and a time interval meter. The mechanism of ultrashort pulse generation during synchronization of stimulated Mandel'shtam-Brillouin scattering components is confirmed. Figures 1; references 3 Russian.

USSR

UDC 621.373.535

AN OPTICAL RING RESONATOR WITH A DIAPHRAGMED SPHERICAL MIRROR AND A SPATIALLY HETEROGENEOUS AMPLIFYING MEDIUM. PART 1

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA - FIZIKA-KHIMIYA in Russian No 10, Issue 2, May 79 pp 35-41 manuscript received 5 Jul 77

BOYTSOV, V. F. and SLYUSAREV, S. G.

[Abstract] The fields and frequency spectrum are calculated for the oppositely directed waves in a diaphragmed resonator with a spatially heterogeneous amplifying medium. Since the precise solution of this problem requires cumbersome machine calculation, models are studied for which closed

analytic solutions are available. The model selected is a ring resonator with two flat mirrors and one spherical mirror, with a diaphragm with normal distribution of transmission. Within the resonator is a square-law medium, the axis of symmetry of which passes through the optical axis of the empty resonator. One advantage of this model is that it allows determination of the basic properties and peculiarities of the actual physical system. The model problem is formulated, the optical path length in the heterogeneous medium is calculated, an integral equation is derived for the field in the resonator with the diaphragm, and the equation is solved to determine the field of the oppositely directed waves, threshold conditions and resonator frequency. Figure 1; references 15: 13 Russian, 2 Western.
[98-6508]

USSR

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ANNULAR OPTICAL RESONATOR WITH IRISED SPHERICAL MIRROR AND SPATIALLY INHOMOGENEOUS AMPLIFYING MEDIUM. II

Moscow VESTNIK LENINGRADSKOGO UNIVERSITETA: FIZIKA, KHIMIYA in Russian No 16, Issue 3, Aug 79 pp 38-44 manuscript received 5 Jul 77

BOYTSOV, V. F. and SLYUSAREV, S. G.

[Abstract] The first part of the paper was published in "Vestnik Leningradskogo universiteta," No 10, 1979 pp 35-41. On the basis of integral equations for open resonators, formulas were derived for the spatial distribution of the fields of opposed waves, the frequencies and threshold conditions in an amplifying medium partly filling a ring cavity with two flat mirrors and one spherical mirror. In the second part, a physical analysis is made of the results, and the caustic surfaces of zero modes are calculated for opposed waves inside the medium. The change in relation to an empty cavity is determined for the volumes of the fields between caustics due to diffraction by a gaussian diaphragm on the spherical mirror, and by the inhomogeneities of the amplifying medium. The equiphase fronts of the opposed waves are also calculated. It is found that the presence of a gaussian diaphragm on the spherical mirror and an amplifying medium that is "quadratic" in the transverse direction results in distortion of the caustics of the opposed waves. The relative deformation of the caustics depends on the losses in the cavity, and is less for cavities that are close to flat or concentric. References 4 Russian.
[93-6610]

USSR

UDC 548.535

THE STIMULATED EMISSION OF MIXED MOLECULAR CRYSTALS AT LOW TEMPERATURES
(REVIEW)

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 31 No 2, Aug 79 pp
189-204 manuscript received 24 Jul 78

NABOYKIN, YU. V. and OGURTSOVA, L. A.

[Abstract] The specific features of the stimulated emission from mixed crystals excited in the impurity absorption band by a high power laser and cooled down to a temperature at which their electron spectra undergo substantial changes, become line spectra and exhibit easily resolvable vibrational structures are treated in this survey of recent literature. The following topics are covered: the influence of the relaxation of intramolecular vibrations on the stimulated emission spectrum; the influence of electron-phonon interaction on the stimulated emission spectrum of mixed crystals; lasers using mixed molecular crystals at low temperatures; the polarization of the radiation and its manifestation in stimulated emission. Relaxation times for the vibrational levels of such crystals as naphthalene, phenyl-beta-naphthyldivinylbenzene and numerous others are presented in tabular form along with data on the lasing of mixed molecular crystals at 4.2 K. The practical importance of research on these crystals is indicated: the narrow lasing lines, the large pumping energy conversion gain and the frequency stability make mixed crystals promising media for solid state and gas lasers. Figures 11; references 40: 29 Russian, 11 Western.
[186-8225]

USSR

UDC 621.378.525

A HELIUM-NEON LASER FOR CARBON DIOXIDE GAS ANALYSIS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 31 No 2, Aug 79 pp
236-241 manuscript received 28 Aug 78

MIRONOV, V. D., POPOV, A. I. and PROTSENKO, YE. D.

[Abstract] The output power of a 4.2 micrometer helium-neon laser is optimized theoretically and checked experimentally. He-Ne lasers using the $3s_2-3p_1$ 4.2 micrometer transition of neon, where this wavelength is effectively absorbed by CO_2 , can be used to make highly sensitive, high speed meters of CO_2 concentration. However, previous output powers with this transition have been low and difficult to record. The reason for this is

the nonoptimal choice of the active medium parameters, the resonator and the manner of lasing suppression at competing neon transitions of $3s_2-3p_4$ at 3.3922 micrometers and $3s_2-3p_2$ at 3.3912 micrometers. Structural modifications of an LG-75 laser to circumvent these difficulties are described, and an output power of 2.8 mW is reported; this figure is close to the theoretical maximum for lasers of this configuration. Simple analytical expressions are given for the absorption and emission probabilities of the relevant transitions, as well as the related output power. Figures 2; references 15: 5 Russian, 10 Western.
[186-8225]

USSR

UDC 621.378.325

A RHODAMINE 6G DYE LASER USING A REFERENCE STANDARD SOLUTION AND AN UNSTABLE RESONATOR

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 31 No 2, Aug 79 pp 242-245 manuscript received 11 Aug 78

BARIKHIN, B. A., BOROVKOV, V. V., FEDOSIMOV, A. I. and YAKOVLEV, V. I.

[Abstract] Dye lasers using rhodamine 6G in configurations with flat and telescoping resonators were used to experimentally determine the optimal parameters of an astable resonator and evaluate its efficiency. An LG-55 He-Ne laser was used for the initial adjustment of the resonator and the final adjustment was accomplished with an AK-400 telescope after the solution attained optimal homogeneity. The spacing between the reflectors was determined by the degree of optical homogeneity of the solution and varied in a range of 0.8-1.3 m. The linear magnification of the resonator M , varied from 3.2 to 6.0 due to the changing diameter of the output reflector. The optimal operating mode of an astable resonator laser is achieved at a value of $M = 3.5$ and the optimum rhodamine 6G concentration in the solution is always less in the case of the astable resonator ($2 \cdot 10^{-5}$ mole/liter) than for a flat resonator ($2.6 \cdot 10^{-5}$ mole/liter). Photographic and calorimetric measurements of the far field distribution show that in a laser with an astable resonator, 50% or more of the generated radiation energy is liberated in an angle of less than $8 \cdot 10^{-3}$ rad under optimum conditions, while less than 20% of the energy of a flat resonator laser is radiated at this angle. A distinctive feature of rhodamine 6G laser operation in a reference standard with an astable resonator is the appearance of two or more kinds of different intensity in the spectrum instead of a broad continuous band, which is characteristic of lasers with flat resonators. The maximum radiation energy achieved in the astable resonator case was 300 joules at

an energy efficiency of 0.75% relative to that stored in the capacitor bank. It is shown that flat resonator lasers are less efficient than an astable one and the use of astable resonators for organic dye lasers allows for a substantial improvement in the parameters of the generated radiation pulse. No quantitative accounting for the results is given. Figures 4; references 5 Russian.
[186-8225]

USSR

UDC 621.378.34

THE SPECTRAL LUMINESCENCE AND LASING CHARACTERISTICS OF 2-(4-BIPHENYLYL)-5-PHENYLOXAZOLE

Minsk ZHURNAL PRIKLADNOY SPEKTRASKOPII in Russian Vol 31 No 2, Aug 79 pp 257-264 manuscript received 31 Aug 78

GRUZINSKIY, V. V. and SUCHKOV, V. I.

[Abstract] The lasing properties of a number of new active media based on aryl derivatives of oxazole and oxadiazole are studied. The absorption, fluorescence, phosphorescence, superluminescence and lasing spectra of two compounds are investigated: 2-(4-biphenylyl)-5-phenyloxazole (BPO) and (1,4-bis[2-(5-phenyloxazolyl)]benzene) (POPOP). The second harmonic of a ruby laser employing a telescopic system was used for pumping, where the maximum energy converted by a KDP single crystal was 0.12 J, and the base pulse width was 50 nanoseconds. Transverse pumping was used and a diffraction grating was used as one of the resonator reflectors for tuning the wavelength. In the fluorescence spectra of BPO and POPOP, linear bands at about 357, 380 and 420 nanometers are the strongest, where these are due to the emission of molecular nitrogen formed during the destruction of the oxazole ring of the molecules. BPO and POPOP molecules are less stable in a discharge than aromatic compounds such as anthracene or perylene. Lasing of these compounds was obtained in cyclohexane, pentane, dioxane, ethyl acetate, cyclohexanone, toluene, ditolylmethane and alpha-methylnaphthalene in concentrations ranging from 0.05--2 g/l. The experiments with a one meter long resonator show that these aryl derivatives are capable of strong lasing and fluorescence in the above mentioned vapors and solutions with optical excitation; they are promising as the active media in the search for lasing in an electric discharge. Figures 5; references 16: 14 Russian, 2 Western.
[186-8225]

USSR

UDC 621.378.325

AN ELECTRON-BEAM-CONTROLLED LASER FACILITY WITH A COOLED ACTIVE REGION

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 49 No 12, Dec 79 pp 2629-2636 manuscript received 31 Mar 79

BASOV, N. G., DANILYCHEV, V. A., IONIN, A. A., KAZAKEVICH, V. S., KOVSH, I. B., PANTELEYEV, G. V., POLETAYEV, N. L., SOBOLEV, V. A. and TROITSKIY, V. F., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] For purposes of studying the temperature dependences of the energy, time and spectral characteristics of molecular lasers, an experimental facility was developed for electron-beam excitation of a lasing medium with a volume of about 5 liters at initial temperatures from 80 to 300 K. The installation operates at gas densities of up to 3 amagat units, and is suitable for typical working mixtures of electron-beam-controlled CO and CO₂ lasers, providing specific energy inputs of up to 300-500 J/liter × amagat unit. The duration of the pumping pulse can be varied over a range from about 1 to 500 μs. The facility is used to study the temperature dependence of laser threshold characteristics. Figures 5; references 12: 5 Russian, 7 Western.
[95-6610]

USSR

UDC 621.378.325

METAL SEGMENTED PIPES FOR GAS-DISCHARGE PULSE LASERS

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 49 No 12, Dec 79 pp 2643-2646 manuscript received 11 Feb 79

KRAVCHENKO, V. F., GUDKOV, A. A., KARABUT, E. K. and MIKHALEVSKIY, V. S., Scientific Research Institute of Physics at Rostov-na-Donu State University

[Abstract] Segmented metal tubes are widely used for cw lasing in argon and carbon dioxide. The authors investigate the feasibility of such tubes for pulse lasers. The analysis is based on an ultraviolet nitrogen gas-discharge laser. The discharge tubes were 20 cm long with diameter of the envelope of 3 cm. Aluminum segments were used with thicknesses ranging from 0.01 to 1.8 cm with spacing from 0.1 to 4 cm. The diameter of the discharge section was a constant 0.3 cm. It is shown that for the same source of excitation and the same volume, a segmented metal tube has greater lasing power than

conventional dielectric discharge tubes. The lasing efficiency in the segmented metal tube is 0.02-0.035%, which is close to the value for dielectric tubes. The experimental results are interpreted in terms of the hypothesis of a hollow-cathode effect in the segments. Figures 4; references 5: 3 Russian, 2 Western.
[95-6610]

USSR

UDC 621.378.325

CHARACTERISTICS OF THIN-FILM METALLIZED MIRRORS FOR PULSED LASER SYSTEMS

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 49 No 12, Dec 79 pp 2662-2666 manuscript received 16 Apr 79

VOLYAK, T. B., GALKINA, N. S., KRASYUK, I. K., PASHININ, P. P., TROFIMOVA, A. A. and SHARAFUTDINOVA, D. I., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] An investigation is made of metallized mylar films used as laser mirrors. The mirror surface is formed by stretching the film on a special frame over a cavity where a pressure drop is set up to produce the required curvature. Wrinkles and warps are removed by annealing followed by slow cooling. A shadow technique was used for studying the mirrors with a helium-neon laser light source. An aluminized glass mirror was used as the standard. It was found that a gold mirror on mylar film is best able to withstand laser radiation. The threshold of destruction of such a mirror is 1.5 J/cm^2 for radiation on $1.06 \mu\text{m}$ at a pulse duration of 40 ns, and 12 J/cm^2 for radiation on $10.6 \mu\text{m}$ at a pulse duration of 200 ns. The authors were able to achieve lasing in a cavity formed by a flat and a concave polymer mirror with transverse discharge in CO_2 . The most suitable base is $3 \mu\text{m}$ mylar. These film mirrors are easy to make, inexpensive and the parameters can be rapidly altered with considerable working areas. They should be competitive with conventional metal and glass mirrors. Figure 1; references 7: 6 Russian, 1 Western.
[95-6610]

USSR

UDC 530.145.61+530.182

QUANTUM RESONANCE FOR A ROTATOR IN A NONLINEAR PERIODIC FIELD

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 249 No 5, 1979 pp 1103-1107 manuscript received 21 May 79

IZRAYLEV, F. M. and SHEPELYANSKIY, D. L., Institute of Nuclear Physics, Siberian Department, Academy of Sciences USSR, Novosibirsk

[Abstract] In studying the behavior of nonlinear quantum systems under the action of an external periodic perturbation, mathematical difficulties arise in theoretical analysis when the perturbations cannot be considered small. In previous numerical studies of a flat rotator subjected to delta-function impulses it has been found that the quantum system shows considerable difference from classical behavior when motion becomes stochastic. In particular, the rate of diffusion of the average energy of the rotator coincides with classical behavior only for limited times, and then drops sharply, even when the system is patently quasi-classical. In addition such a system shows a peculiar type of motion called quantum resonance, that has no analog in the classical system. In this paper it is shown that for quantum resonances in which the system is everywhere dense, the asymptotic dependence of rotator energy on time is universal and is described by a quadratic relation. This means that in resonance there is no quantum limit of stability as observed in the non-resonator case. It is also noted that there is no classical stability criterion even though the system may be patently quasi-classical. This quantum resonance effect may be useful in investigating the problem of rapid excitation of quantum systems by short laser pulses. The authors thank B. V. Chirikov for interest in the work and constructive criticism, G. M. Zaslavskiy, I. A. Malkin, V. V. Sokolov and S. A. Kheyfets for stimulating discussions, and also L. F. Khaylo for assisting with the calculations. Figure 1; references 14: 9 Western, 5 Russian.
[86-6610]

USSR

UDC 517.91/94:519.3

DETERMINING THE STRUCTURE OF GENERALIZED SOLUTION OF A NONLINEAR OPTIMUM CONTROL PROBLEM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250 No 3, 1980 pp 525-528
manuscript received 9 Jul 79

VASIL'YEVA, A. B. and DMITRIYEV, M. G., Moscow State University imeni M. V. Lomonosov and Computer Center of the Siberian Department of the USSR Academy of Sciences, Krasnoyarsk

[Abstract] Investigation of pulses and special control sections that are optimum in the sense of Pontryagin's maximum principle by regularization of the input problem and subsequent asymptotic analysis by the method of boundary functions found during regularization of singularly disturbed problems can be applied to a class of nonlinear optimum control problems. Based on the sequential approach in the theory of generalized functions, the solvability of the nonlinear input problem of functional minimization in some set of generalized functions is established. A system of equations is derived to prove the proposed hypotheses. References 12: 10 Russian, 2 Western.

USSR

UDC 517.946

THE SOLVABILITY OF THE NONLINEAR DIRICHLET PROBLEM IN A NARROW BAND

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250 No 3, 1980 pp 569-573
manuscript received 9 Jul 79

SKRYPNIK, I. V., Institute of Applied Mathematics and Mechanics of the USSR Academy of Sciences, Donetsk

[Abstract] The existence of the classical solution of the Dirichlet problem for a general nonlinear elliptical equation in a narrow band is established. The condition of the narrowness of the band does not assume the smallness of the measure of this band since the measure of the band can be arbitrary. A series of equations is derived to prove the hypothesis. References 3 Russian.

USSR

UDC 535.373

DIAGNOSIS OF THE MOLECULAR STATES OF CARBON DIOXIDE ACCORDING TO THE RESONANCE ABSORPTION OF CO₂ LASER RADIATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 249 No 6, 1979 pp 1353-1356
manuscript received 17 Jul 79

ACHASOV, O. V., LABUDA, S. A., SOLOUKHIN, R. I. and FOMIN, N. A., Minsk,
Institute of Heat and Mass Transfer imeni A. V. Lykov, Belorussian SSR
Academy of Sciences

[Abstract] Experimental data on the coefficient of resonance absorption in carbon dioxide in the 9.6 μm region were used to determine the Einstein coefficient of the transition $02^{\circ}1 \rightarrow 00^{\circ}1$ for the P20 line: $A_{21} = 0.16 \text{ s}^{-1}$. The experiments were performed with the aid of a CO₂ laser using an absorption "cell" represented by a CO₂ region that was uniformly compressed and heated by means of a shock wave. On this basis the possibilities for utilizing the processes of the resonant absorption of laser radiation by CO₂ as a means of diagnosing the molecular states of the gas are analyzed, considering by way of an example a method for determining the rotational (and hence also translational) and vibrational temperatures of the gas under inequilibrium conditions. A corresponding formula is presented. The theoretical findings are found to be in agreement with experiment. Figure 1; references 10: 5 Russian, 5 Western.
[87-1386]

USSR

DIFFUSION IN TOROIDAL TRAPS WITH REGARD TO ELECTRONIC ANOMALY

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 31 No 2, Jan 80 pp 88-92 manuscript received 3 Nov 79

YUSIMANOV, P. N., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] The increased transport in the tokamak by anomalous longitudinal electron viscosity is explained as equivalent to application of an additional poloidal pulse compared to neoclassical attenuation. A system of transport equations was found as the first step without regard to heat flux and thermal diffusion, which is explained as a rapid increase of the plasma pinch. The equations show that the diffusion flux and abnormal electron behavior vary within the range from neoclassical to pseudoclassical theory. A simple electron-ion plasma is used as the experimental model. Figures 2; references 5: 3 Russian, 2 Western.

USSR

THE CURRENT STRUCTURE OF A PLASMA FOCUS AT THE MOMENT OF FAST PARTICLE GENERATION

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 31 No 2, Jan 80 pp 131-135 manuscript received 7 Dec 79

FILIPPOV, N. V., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] A complex structure of localized regions of fast electron generation in the mega-electron-volt range was found experimentally at the plasma focus during azimuth breakdown of the current shell. There is no relationship between the soft X-ray image of the axial discharge zone and the nature of spectral distribution of fast deuterons, but particle acceleration is related to dynamic dissipation of the magnetic field upon recombination of the magnetic lines of force. A direct relationship of current filamentation to fast particle generation in the mega-electron volt range at a plasma focus is indicated. The generated fast particles do not determine the neutron emergence from the plasma focus, but are the main cause of hard radiation generation from a linear Z-pinch. Figures 5; references 5 Russian.

USSR

UDC 621.373.382.826

FLUORESCENT FIBER-OPTIC LIGHT CONCENTRATORS

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR - SERIYA FIZIKO-MATEMATICHESKAYA in Russian No 6, Nov/Dec 79 pp 32-35 manuscript received 27 Dec 78

AYTKHOZHIN, S. A. and AKANAYEV, B. A., Kazakh State University imeni S. M. Kirov, Alma-Ata

[Abstract] The parabolic, spherical or other rigid light concentrators used earlier were expensive structures requiring systems for tracking the sun. The use of fluorescent light collectors allows replacement of expensive semiconductor materials for energy conversion with cheaper plastic, dye-activated materials such as coumarin or glass activated with rare-earth elements. These materials absorb light over a broad range of wavelengths, then reradiate in a narrow frequency interval, so that they can be selected to reradiate in the optimal range of frequencies of a semiconductor convertor. They are also capable of concentrating not only direct light but also diffuse, scattered light, so that sun-tracking systems are not necessary. This article describes two methods to avoid one significant shortcoming of fluorescent materials, related to their high level of natural absorption. One is by "drainage" of the light flux with optical fibers. Another is to construct optical fiber concentrators in several layers, covered with envelopes of various dyes selected so that each layer of fiber overlaps and converts a large portion of the light in the solar spectrum, collecting narrow-band radiation from each layer of fiber and sending it to a semiconductor convertor. A system efficiency of at least 35% can be achieved. Figure 1; references 6: 2 Russian, 4 Western.

[91-6508]

USSR

THE WIDTH OF SPECTRAL LINES IN A MOLECULAR NON-EQUILIBRIUM PLASMA

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 31 No 3, 5 Feb 80 pp 188-191 manuscript received 28 Dec 79

ZHUK, D. V., OTORBAYEV, D. K., OCHKIN, V. N., SAVINOV, S. YU. and SOBOLEV, N. N., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] A pressure-scanned Fabry-Perot standard crossed with a type DFS-8 monochromator was used to record the 2^+ radiation of the N_2 system in a discharge in a tube 20 mm in diameter with a discharge current of 20 mA in mixtures of N_2+He and N_2+Ar at a tube wall temperature of 77 K. Anomalous

expansion of spectral lines was discovered. It is concluded that this expansion results from nonresonant interactions among heavy particles, producing "hot" groups of molecules, for which the mean energy of rotary motion exceeds the thermal energy. Three possible mechanisms are suggested for formation of the "hot" groups of molecules. "Sorting" of electron-excited molecules of N_2 by velocities as a function of the energy of the coupled state is observed. Figures 2; references 3: 2 Russian, 1 Western.
[99-6508]

USSR

UDC 681.883.677

STATISTICAL PROBLEM IN SYNTHESIS OF AN ANTENNA ARRAY

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 26 No 1, Jan/Feb 80 pp 67-73
manuscript received 22 Jan 79

ZHUKOV, V. B.

[Abstract] The problem of improving the directional characteristic of antenna arrays by proper staggering of the elements is considered here, taking also into account fluctuations of the parameters of the medium. The directional characteristic is assumed to be given, the radiation pattern having been determined with random errors at every point in space. These errors are due to compounding of random errors in the distribution of vibrational velocity over the aperture and random inhomogeneities in the medium. The object is to determine the parameters of the statistical distribution of vibrational velocities over elements of the array which will yield the closest mean-square approximation to the given radiation pattern. This problem of antenna synthesis in operator form reduces to an Euler equation with a Lagrange multiplier acting as the regularization parameter, and is solved by the Rytov method of smooth perturbations. Typical results are shown for a linear array of 31 elements with a quarter-wavelength spacing. Figures 6; references 10 Russian.

[106-2415]

USSR

UDC 519.25:681.142.2

SPIRAL SCANNING DATA TRANSMISSION PROGRAMS FOR THE BESM-6 COMPUTER AND THEIR CONVERSION TO FILTRATION-BLOCK FORMAT

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR - SERIYA FIZIKO-MATEMATICHESKAYA in Russian No 6, Nov/Dec 79 pp 78-82 manuscript received 8 Sep 78

SKOROBOGATOVA, V. I., YELUBAYEV, K. and LASAYEVA, P. YE., Institute of High Energy Physics, Kazakh SSR Academy of Sciences, Alma-Ata

[Abstract] A spiral measuring system consists of two devices and is used to measure the coordinates of tracks on bubble-chamber photographs. A control computer receives data from all units of the system, tests them and records the results of scanning on magnetic tape. Subsequent off-line processing requires programs which can convert data from the control computer format to the format of large computers. This article describes programs developed by the authors to convert data from the E-100 control computer format to the

intermediate format of the BESM-6 computer and then to the format for the filtration and calibration programs. The program is modular and is written in FORTRAN. Processing of bit-byte information is performed using a GENERAL SECTION subroutine, significantly expanding the capabilities of FORTRAN. Figures 4; references 4 Russian.
[91-6508]

6508

CSO: 1862

USSR

UDC 534.12

WAVES IN A FINNED CYLINDRICAL SHELL IMMersed IN A FLUID

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 26 No 1, Jan/Feb 80 pp 84-90
manuscript received 23 Jan 79

KANDIDOV, V. P. and SHENYAVSKIY, L. A., Chair of Physics, Moscow State University imeni M. V. Lomonosov

[Abstract] The authors consider an infinitely long circular cylindrical shell with stiffening hoops and the effect of dynamic deformation of these hoops on the dispersion characteristics of the shell, this shell being immersed in an ideal fluid or, for comparison, making no contact with it. Assuming that the wave of resonant vibrations is longer than the period of the hoop array, so that the orthotropic model applies to this structure, the equations of elasticity in the linear approximation with negligible rotational inertia describe such a system. In the case of thin hoops their longitudinal vibrations are negligible relative to their flexural vibrations and the equation of motion can be solved accordingly. An analysis of the dispersion characteristic near resonances indicates the possibility of reducing the number of propagating modes as well as the amplitude of vibrations within certain frequency ranges by proper redesign of the hoops. Figures 5; references 8 Russian.
[106-2415]

USSR

UDC 534.222.2

STRUCTURE OF THE FRONT OF A SHOCK WAVE IN A POROUS SOLID MEDIUM

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСКОY FIZIKI in Russian No 5, Sep/Oct 79 pp 106-114

DUNIN, S. Z. and SURKOV, V. V., Moscow

[Abstract] Propagation of shock waves through a porous solid medium is considered, assuming the width of the wave front to be much larger than the characteristic dimension of the cellular array. Any one porous cell of the body thus moves as an entity in the wave front while being compressed at the same time. The deformation process is analyzed, first in the case of an incompressible solid phase with only a change in porosity under pressure. A general equation describing the wave front structure in terms of the macroscopic porosity is then derived which applies to a generally viscoelastic

body and thus allows plastic flow of the solid phase to be taken into account between the two extremes of zero viscosity and zero inertia. The propagation of shock waves is found to be determined by the dependence of the pressure on the density as well as on its first and second derivatives with respect to time. The width of the wave front depends on the geometry of the porous space in the case of weak shock waves and also on the velocity in the case of strong waves. Figures 4; references 13: 7 Russian, 6 Western.

[105-2415]

USSR

UDC 539.374

NUMERICAL SIMULATION OF COMPRESSION AND RAREFACTION WAVES IN METALS

Novosibirsk ZHURNAL PRIKLADNOY MEKhanIKI I TEKHNIChESKOY FIZIKI in Russian No 5, Sep/Oct 79 pp 114-122 manuscript received 18 Sep 78

FOMIN, V. M. and KHAKIMOV, E. M., Novosibirsk

[Abstract] An isotropic medium is considered through which compression and rarefaction waves propagate, the state of such a medium being characterized by stress and strain tensors as well as a velocity vector and an internal energy. The strain-rate tensor here is the sum of two components representing elastic and plastic strain respectively. The propagation and the interaction of compression and rarefaction waves are described by the laws of mass, energy and momentum conservation, expressed here in Lagrange coordinates, and the closing equation of heat balance in additive form containing the Grueneisen parameter. These concepts are applied to strong shock waves in metals, as in the case of impact between two plates. The problem was solved numerically according to the Wilkinson difference scheme, assuming a deviator component of stress much smaller than the stress jump at the wave front and disregarding the thermal components at wave velocities below 4 km/s, on the basis of three different models of uniaxial deformation: the dislocation model, the hydrodynamic model, and the elastoplastic model with hardening. Depending on the impact parameters, and especially at higher wave velocities, all these models have yielded results in fair agreement with experimental data for aluminum, also copper, iron and lead. Figures 6; references 18: 11 Russian, 7 Western.

[105-2415]

THERMOELASTIC STRESSES IN PIECEWISE-HOMOGENEOUS STRUCTURES

Novosibirsk ZHURNAL PRIKLADNOY MEKhanIKI I TEKHNIChESKOY FIZIKI in Russian
No 5, Sep/Oct 79 pp 135-143 manuscript received 28 Sep 78

BELEYCHEVA, T. G., Novosibirsk

[Abstract] Thermoelastic stresses in piecewise-homogeneous structures are analyzed, a radially and axially piecewise-homogeneous straight circular cylinder being selected as the mathematical model encompassing any number of different configurations. The problem is treated as a linearly elastic case with axial symmetry, assuming an absence of external forces and assuming temperature change to be uniform throughout this effectively compound cylindrical domain. With zero stresses at the outer surface and with continuity of stresses and displacements at the inner boundaries, the Duhamel-Neumann equations of equilibrium are reduced to variational form with respect to minimum potential energy of the system. The algorithm of the solution involves a finite-difference scheme with $O(h^2)$ -order accuracy and a modular diagonal matrix to which the numerical method of successive upper linear modular relaxation is applicable. Calculation of stresses shown here for a model representing microelectronic devices with crystals mounted in a case. As a result of such a calculation with the best fitting cylinder configuration, radial and axial profiles of normal and tangential components of thermal stress are found in a typical system consisting of silicon and Polycore ferrite in boron-lead glass. The author thanks K. K. ZILING for the discussion. Figures 3; tables 3; references 26: 6 Russian, 20 Western. [105-2415]

DEPENDENCE OF THE CRITICAL CONDITIONS IN BRITTLE FRACTURE ON THE INDENTER SURFACE GEOMETRY AND DIMENSIONS

Novosibirsk ZHURNAL PRIKLADNOY MEKhanIKI I TEKHNIChESKOY FIZIKI in Russian
No 5, Sep/Oct 79 pp 143-150 manuscript received 23 Oct 78

KAGANOVA, I. M., Moscow

[Abstract] Brittle fracture under an indenter having a $z = Ar^{2\lambda}$ surface profile is considered, with the free energy and its derivative with respect to the crack length serving as criteria of transition from quasi-steady to unstable crack propagation. On the premise that the parameters of brittle

fracture are determined by the dependence of the contact area and thus of the contact stress on the indenter geometry under a given load force, by extension of the Hertz problem, the maximum pressure is calculated which develops under such indenters prior to fracture and found to be highest under a nearly conical one ($\lambda \rightarrow 1/2$). Data on spherical indenters can and should be used for practical estimates for the design of high-pressure equipment such as a Bridgeman anvil. The author thanks R. G. ARKHIPOV for having thoroughly familiarized himself with this study and having suggested changes resulting in a more comprehensible presentation, also B. V. VINOGRADOV, G. N. YERMOLAYEV, A. V. RAKHMANINA and YE. N. YAKOVLEV for the interest and helpful discussion. Figures 2; references 12: 7 Russian, 5 Western. [105-2415]

USSR

DYNAMIC BIREFRINGENCE IN A SUPERFLUID

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 31 No 3, 5 Feb 80 pp 191-193 manuscript received 29 Dec 79

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[Abstract] In a superfluid, two types of macroscopic movement are possible. Therefore, the dielectric permeability tensor may depend on the relative velocity. Birefringence appears, i.e., a difference in the dielectric permeability for light polarized along a vector relative to the velocity and in the perpendicular direction. A method is presented for calculating the birefringence constant. The effect in question is thermodynamically related to the appearance of anisotropy in the density of the normal component of the fluid in an external electric field. References 2 Russian.
[99-6508]

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